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Emotion regulation meets emotional attention: The influence of emotion suppression on emotional attention depends on the nature of the distracters

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Abstract

Recent evidence has suggested a crucial role of people's current goals in attention to emotional information. This asks for research investigating how and what kinds of goals shape emotional attention. The present study investigated how the goal to suppress a negative emotional state influences attention to emotion-congruent events. After inducing disgust, we instructed participants to suppress all feelings of disgust during a subsequent dot probe task. Attention to disgusting images was modulated by the sort of distracter that was presented in parallel with disgusting imagery. When disgusting images were presented together with neutral images, emotion suppression was accompanied by a tendency to attend to disgusting images. However, when disgusting images were shown with positive images that allow coping with disgust (i.e., images representing cleanliness), attention tended away from disgusting images and towards images representing cleanliness. These findings show that emotion suppression influences the allocation of attention but that the successful avoidance of emotion-congruent events depends on the availability of effective distracters.

Key words: Emotional Attention, Emotion Regulation, Suppression, Goals, Disgust

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Emotional events bias attention (Vuilleumier & Huang, 2009). Yet, the way in which attention is biased varies. The majority of studies has demonstrated enhanced attention to negative events, especially in negative emotional states (Yiend, 2010), but other studies have described attentional avoidance of aversive stimuli (Huijding, Mayer, Koster, & Muris, 2011; Mathews & Sebastien, 1993). Likewise, attention is sometimes deployed to positive instead of negative information (Fox, Ridgewell, & Ashwin, 2009). How can this variance be explained? Here, we suggest that emotion regulation goals are a key factor in shaping emotional attention (cf. Ellenbogen, Schwartzman, Stewart, & Walker, 2002; Wadlinger & Isaacowitz, 2011).

Our approach is grounded in recent findings showing that motivational processes shape attention to emotional information (Rothermund, Voss, & Wentura, 2008; Vogt, De Houwer, Crombez, & Van Damme, 2013). For instance, attentional biases to threat vanish when threatening information is irrelevant to people's current goal (Hahn & Gronlund, 2007; Vogt et al., 2013). Moreover, negative emotional states are accompanied by attention to stimuli that allow alleviating the emotion such as images representing cleanliness in disgust (Vogt, Lozo, Koster, & De Houwer, 2011). These findings suggest that emotional attention is not stimulus-driven and goal-independent (LeDoux,1996) but that temporary goals such as aiming to cope with an aversive situation have a profound role in emotional attention.

In a related vein, models of emotion regulation consider attention as one of the primary mechanisms by which people regulate emotions (Gross & Thompson, 2007; Koole, 2009). These accounts predict that also more direct emotion regulation strategies influence attention. Indeed, people increase overt looking to positive pictures when aiming to feel happy (Xing & Isaacowitz, 2006). Moreover, training specific attentional patterns to emotional events supports successful emotion regulation (Johnson, 2009). Here we aim to extend this work by investigating how emotion suppression influences the allocation of attention.

Emotion suppression is a frequent regulation strategy in negative emotions (Koole, 2009). We refer to emotion suppression as the attempt to inhibit experiencing an emotion. Importantly, emotion suppression seems to be counterproductive because it ironically increases the to-be-suppressed emotion (Wegner, Erber, & Zanakos, 1993). Relatedly, Lavy and van den Hout (1994) found that suppressing thoughts of numbers causes response interference by number words. These findings suggest that emotion suppression will not cause attentional avoidance but attention towards emotion-congruent events.

Yet, the direction of attention to emotion-congruent information might also depend on the available distraction. For instance, using focused distracters during thought suppression attenuated the rebound of suppressed information (Wegner, Schneider, Carter, & White, 1987). Similarly, engaging attention by potent distracters such as information relevant to people's current goal prevents attentional capture by salient events (Folk, Ester, & Troemel, 2009; Vogt et al., 2013). Applied to emotion suppression, an effective distracter might be positive information that is helpful in achieving the goal of emotion suppression.

On the basis of these considerations, we suggest that suppressing a negative emotion will be accompanied by attention towards emotion-congruent events but will also allow their attentional avoidance when effective distracters are available. To test this prediction, we induced disgust by having people touch disgusting objects. Participants in the experimental condition were instructed to suppress all feelings of disgust during the subsequent attention task. In this task, two cues are concurrently presented at two different locations on the screen, immediately followed by a single probe (MacLeod, Mathews, & Tata, 1986). Selective attention for the first relative to the second cue is indicated by fast reactions to probes in the location of the first cue relative to probes in the location of the second cue. We expected preferred attention to disgusting images on trials comparing disgusting to neutral imagery. However, on trials showing

disgusting images together with images representing cleanliness, we predicted attention to be allocated away from disgusting and towards clean images because clean stimuli allow alleviating disgust (Vogt et al., 2011) and should therefore represent effective distracters.

Method

Participants

Thirty-eight students at Ghent University (25 women; M_{age} = 18.76 years, SD_{age} = 1.42 years) participated to fulfill course requirements and were randomly assigned to conditions.

Apparatus and Materials

Induction Procedure and Pictorial Cues.

Disgust induction procedure and cue images were taken from Vogt et al. (2011). For the induction, we used fake stimuli such as plastic maggots. Ten images were implemented for each cue category (disgusting, clean, neutral). Neutral images were taken from the International Affective Picture System (Lang, Bradley, & Cuthbert, 1999). Images were rated for disgustingness, cleanliness, and valence by 20 students at Ghent University (16 women; M_{age} = 22.55 years, SD_{age} = 6.51 years).[1] See Appendix for further details on all stimuli.

Procedure

The experiment was presented on a Dell Dimension 5000 computer with an 85 Hz, 17-inch CRT monitor using the INQUISIT Millisecond software package (Inquisit 2.0, 2005). During the entire experiment, participants first read the instructions on the screen after which the experimenter repeated them. Participants started with a practice attention task of 82 trials with words as cues.

In order to make sure that participants would follow the *emotion induction and regulation* instructions, the experimenter placed two lubricant electrodes on their left ankle. The electrodes were connected to a physiological measurement instrument that the experimenter turned on. The

experimenter explained to participants thoroughly that we would monitor their skin conductance responses in order to have an objective control measure of their emotional state. Actually, we did not measure anything.

During the disgust induction procedure, the experimenter presented the disgusting objects one after another in a fixed order. For each object, participants had to look at it, for some objects to smell it, to touch it if possible for them, and to imagine that it is real. After being exposed to all objects, participants indicated the most disgusting object. The experimenter exposed participants again to this object. Hereafter, participants indicated how much disgust they felt at this moment (1 = *not at all* to 9 = *very much*). Before participants gave their response, the experimenter turned away ostensibly so that participants felt comfortable to answer honestly.

Then, we instructed participants in the suppression condition to suppress and participants in the control condition to uphold all feelings of disgust during the attention task. The experimenter reminded participants that the electrodes would allow us to measure their actual feelings. The emotion regulation instructions were repeated on the screen three times during the attention task at fixed positions.

A trial in the attention task started with a fixation screen consisting of a black fixation cross (0.61° x 0.57°) on a white background in the middle of the black screen. Two white rectangles (11.29° x 7.93°) were presented above and below the fixation cross (Figure 1). The center of the rectangles was placed 6.47° above and below fixation. After 500 ms, two image cues (11.16° x 7.82°) appeared for 350 or 650 ms in the rectangles. We varied cue presentation time in order to compare the deployment of attention at two stages of processing. A probe (black square, 0.96° x 0.89°) appeared in one of the rectangles immediately after cue offset. Participants had to indicate the location of the probe by pressing one of two keys (“q”, “m”) with left and right index finger on an AZERTY keyboard. We counterbalanced the assignment of

keys to probe locations between participants. A trial ended after a response was registered or 1500 ms had elapsed since probe onset. The following trial started after 200 ms.

The attention task consisted of 384 trials. We presented three different cue combinations in the trials: disgust vs. neutral, disgust vs. clean, and clean vs. neutral. All three combinations were presented with a 350 ms and 650 ms presentation time, each presented 64 times. Each image category was presented equally often in upper and lower location and predicted the probe location correctly on half of the trials. The order of trials was determined randomly and for each participant separately. After the attention task, participants reported their disgust level.

Results

In line with Vogt et al. (2011), we excluded the data of 7 participants who did not reach sufficient disgust levels (i.e., above 5) during the induction procedure resulting in 16 participants in the suppression condition and 15 participants in the control condition.[2]

Self-Reported Disgust Levels

After the disgust induction, the reported disgust level did not differ between suppression (M = 7.13, SD = 0.81) and control condition (M = 7.00, SD = 0.85), $t(29) = .421$, *ns*. After the attention task, the disgust level in the suppression condition (M = 2.13, SD = 1.41) was significantly lower than in the control condition (M = 4.67, SD = 2.09), $t(29) = -3.99$, $p < .001$.

Attention Task

Trials with errors were removed (2.81%). Following Vogt et al. (2011), we used the medians of the reaction times for the analyses. Means and standard deviations can be found in Table 1. We calculated Cohen's *d* to see if the expected differences had small (.20), medium (.50) or large effect (.80) sizes (Cohen, 1992).

To test our hypotheses, the two trial types with disgusting images were analysed using an ANOVA with disgust congruency (congruent, incongruent), type of distracter (neutral, clean)

and SOA (short, long) as within factors and condition (suppression, control) as between factor. A trial was designated as congruent if the probe replaced the disgusting picture and as incongruent if the probe replaced the distracter picture.

Most importantly, this analysis revealed a significant three-way interaction between congruency, distracter, and condition, $F(1,29) = 4.73$, $p = .038$. Furthermore, there was a main effect of SOA, $F(1,29) = 34.78$, $p < .001$, and an interaction between SOA and distracter, $F(1,29) = 5.43$, $p = .027$.[3] The interaction between distracter and congruency approached significance, $F(1,29) = 3.55$, $p = .070$. All other results were not significant, Fs < 1.41.

To further explore the three-way interaction, we calculated separate ANOVAs per condition with disgust congruency (congruent, incongruent) and distracter (clean, neutral) as within factors. We also calculated attentional bias indices for each trial type by subtracting reaction times on disgust congruent trials from reaction times on disgust incongruent trials across SOAs (see Table 1). Positive indices indicate attention towards disgusting images, negative indices indicate attention towards distracters.

The analyses revealed an interaction between distracter and congruency in the suppression condition, $F(1,15) = 8.01$, $p = .013$, $d = 0.71$, but not in the control condition, $F < 1$. This indicates that, in the suppression condition, the attentional bias index for disgusting images when compared to neutral images ($M = 9.58$ ms, $SD = 22.68$ ms) was significantly higher than the index for disgusting images when presented with clean images ($M = -6.47$ ms, $SD = 14.58$ ms). None of the main effects was significant in either condition, Fs < 1.

Finally, we analyzed trials with clean and neutral images using an ANOVA with condition (suppression, control) as between factor and congruency (clean congruent, clean incongruent) and SOA (short, long) as within factors. This analysis revealed only a significant main effect of SOA, $F(1,29) = 43.94$, $p < .001$; all other effects, Fs < 1.

Discussion

The emotional events we pay attention to are a major determinant of what we feel (LeDoux, 1996). Models of emotion regulation therefore suggest that people regulate attention to emotional events when trying to control emotions (Koole, 2009). The present findings support this assumption by showing that emotion suppression influences attention. Importantly, the type of distracter presented simultaneously with disgusting images modulated attention to those images. Suppressing feelings of disgust was accompanied by a tendency to attend to disgusting images when neutral imagery was presented simultaneously. However, when disgusting images were shown together with images representing cleanliness, attention was lent towards the latter images and away from disgusting images.

These results stress the importance of effective distracters. In line with Wegner's work on thought suppression, emotion suppression did not cause attentional avoidance of emotion-congruent events unless effective distraction was present. Whereas Wegner and colleagues (1987) have shown that *focused* distracters (e.g., thinking about a red Volkswagen) help thought suppression, our findings suggest that one category of powerful distracters in emotion suppression are positive stimuli that are tailored to alleviate the specific aversive emotion.

Our findings advance recent accounts suggesting a crucial role for current goals in emotional attention (Rothermund et al., 2008; Vogt et al., 2011, 2013). Emotional attention is often portrayed as stimulus-driven process that is caused by an automatic appraisal of emotional value (LeDoux, 1996). In contrast, newer findings have shown attention to emotional events only when their emotional value is task relevant such as when participants have to classify the emotional value of information (Hahn & Gronlund, 2007; Van Dessel & Vogt, 2012). This evidence suggests that temporary goals underlie emotional attention but it does not explain which goals cause attention to emotional events in everyday life and how they guide attention.

Because emotional attention is associated with aversive emotional states (Yiend, 2010), emotion regulation strategies such as emotion suppression are likely a key factor in determining emotional attention. Notably, emotion suppression appears to cause both attention towards and away from aversive events depending on the context of the aversive imagery.

Future research should address the limitations of the present study. First, given that our effects were small in absolute terms, it would be good to replicate them in subsequent studies. Specifically, future research should try to unravel the processes that underlie the effectiveness of distracters. Notably, clean images in our study did not bias attention in the context of neutral images or in the control condition. This suggests that they were not salient by themselves. It also raises doubts about the hypothesis that participants adopted a strategy of thinking about cleanliness as a way of suppressing disgust because this should have caused attention to cleanliness also in a neutral context (Downing, 2000; Vogt et al., 2011). To shed new light on this issue, future studies could investigate whether only positive stimuli that permit attenuating aversive emotions cause attentional avoidance. Moreover, employing shorter cue presentation times allows to explore how suppression affects earlier attentional responses.

Future research should also examine the influence of other emotion regulation strategies. Surprisingly, participants in the control condition who were instructed to uphold disgust did not display exaggerated attention to disgust. When asked about the strategy they used, the majority reported to have dwelled on memories that were evoked during the emotion induction. This suggests that emotion regulation goals might not only impact which events in the environment grab attention but also whether attention is directed inward or outward. Furthermore, the aim of the present study was to test whether and how emotion suppression influences emotional attention. It therefore allows only limited conclusions about the influence of the reported attentional pattern on the actual success of this strategy. Presumably, attentional avoidance helps

efficient emotion regulation because it prevents subsequent perception of aversive stimulation. Indeed, overtly looking away from aversive stimuli facilitates emotion suppression (van Reekum et al., 2007) but also directing gaze towards aversive information (Bebko, Franconeri, Ochsner, & Chiao, 2011).

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Footnote

[1] Disgusting images were more disgusting and negative than both neutral and clean images, *t*s > 7.45, *p*s < .001, and clean images received higher cleanliness and positivity ratings than both disgusting and neutral images, *t*s > 9.57, *p*s < .001.

[2] None of the reported conclusions changed when these data were included in the analyses.

[3] The main effect of SOA reflects faster reactions on trials with a long SOA (*M* = 441 ms, *SD* = 52 ms) compared to trials with a short SOA (*M* = 464 ms, *SD* = 54 ms). The interaction reflects a tendency for faster reactions on trials with neutral distracters (*M* = 462 ms, *SD* = 53 ms) than with clean distracters (*M* = 467 ms, *SD* = 56 ms) when SOA was short, *t*(30) = -1.40, *p* = 0.173, and a tendency for faster reactions on trials with clean distracters (*M* = 438 ms, *SD* = 48 ms) compared to neutral distracters (*M* = 444 ms, *SD* = 56 ms), when SOA was long, *t*(30) = 1.52, *p* = 0.138.

Appendix

Overview of Images Used as Cues and Stimuli Used for Disgust Induction

An overview of the content of the images used as cues in the attention task and of the stimuli used for the disgust induction procedure

Disgusting Images

Dirty toilet; Overflowed toilet; Cockroach; Vomit; Person vomiting; Maggots; Eyes with abscesses; Pyic blister on finger; Mixture of human slime and blood; Dead wild boar with bloody organs on it. ($M_{disgustingness}$ = 6.84 (1.76), $M_{cleanliness}$ = 1.66 (0.73), $M_{positivity}$ = 2.32 (0.88))

Images Representing Cleanliness

Water drops; Water vortex; Hands holding soap; Washbasin; Shower head; Swimming pool; Person having a bath; Person under water nozzle; Snowy landscape; Water fall. ($M_{disgustingness}$ = 1.74 (1.39), $M_{cleanliness}$ = 8.11 (0.75), $M_{positivity}$ = 7.35 (0.75))

Neutral Pictures

Mushrooms; Farmland; House; Tree branch; Fan; Electric iron; Brown shoes; Hair dryer; Bus; Clothes rack. ($M_{disgustingness}$ = 2.64 (1.83), $M_{cleanliness}$ = 4.86 (0.89), $M_{positivity}$ = 5.23 (0.68))

Stimuli for Disgust Condition

(1) Plastic eye; (2) Crabs and sardines made of slippery plastic with naturalistic scent; (3) Plastic cockroach placed on biscuit; (4) Plastic faeces; (5) Bugs made of slippery plastic with naturalistic scent; (6) Maggots made of slippery plastic with naturalistic scent; (7) WC brush with dry coffee powder in it; (8) Transparent plastic bag filled with food mash resembling vomit; (9) Cotton swabs with dried mustard on it (resembling earwax); (10) Plaster with a dried mixture of ketchup and mustard on it (resembling pyic blood).

Table 1

Mean RTs and Standard Deviations (in ms) as a Function of Trial Type and Congruence in Suppression and Control Condition

	Congruent[a]		Incongruent[b]		Attentional bias indices[c]	
Trial type	*M*	*SD*	*M*	*SD*	*M*	*SD*
Suppression condition						
350 ms						
Disgust vs. neutral	452	49	462	62	10	27
Disgust vs. cleanliness	461	56	457	66	-4	21
Cleanliness vs. neutral	452	54	455	52	3	19
650 ms						
Disgust vs. neutral	436	56	445	67	9	25
Disgust vs. cleanliness	439	48	430	53	-9	20
Cleanliness vs. neutral	433	60	434	61	1	22

			Control condition			
			350 ms			
Disgust vs. neutral	463	55	471	54	8	29
Disgust vs. cleanliness	473	50	476	61	3	38
Cleanliness vs. neutral	458	51	457	48	-1	25
			650 ms			
Disgust vs. neutral	450	52	445	61	-5	37
Disgust vs. cleanliness	440	51	442	50	2	26
Cleanliness vs. neutral	430	47	432	39	2	33

Notes. [a]Congruent refers to trials in which the probe replaced the image category first mentioned under trial type.
[b]Incongruent refers to trials in which the probe replaced the image category mentioned second under trial type.
[c]Attentional bias indices were calculated by subtracting RTs on congruent trials from RTs on incongruent trials.

Figure captions

Figure 1. Schematic overview of a trial in the attention task. A trial started with the presentation of a fixation screen for 500 ms, followed by the presentation of two cue images for 350 ms or 650 ms. Then, a probe (black square) was presented. Participants had to indicate the location of the probe. A trial ended after a response was registered or 1500 ms had elapsed since the onset of the probe. The following trial started 200 ms after a response was registered or the presentation of the probe had ended. The upper cue in this example consists of a image representing cleanliness and the lower cue of a disgusting image.

Figure 2. Attentional bias indices for the different trial types in suppression and control condition. Positive attentional bias indices indicate attention towards the image category first mentioned under trials; negative attentional bias indices attention towards the other image category. Indices are averaged over short and long cue presentation times.

Figure 1.

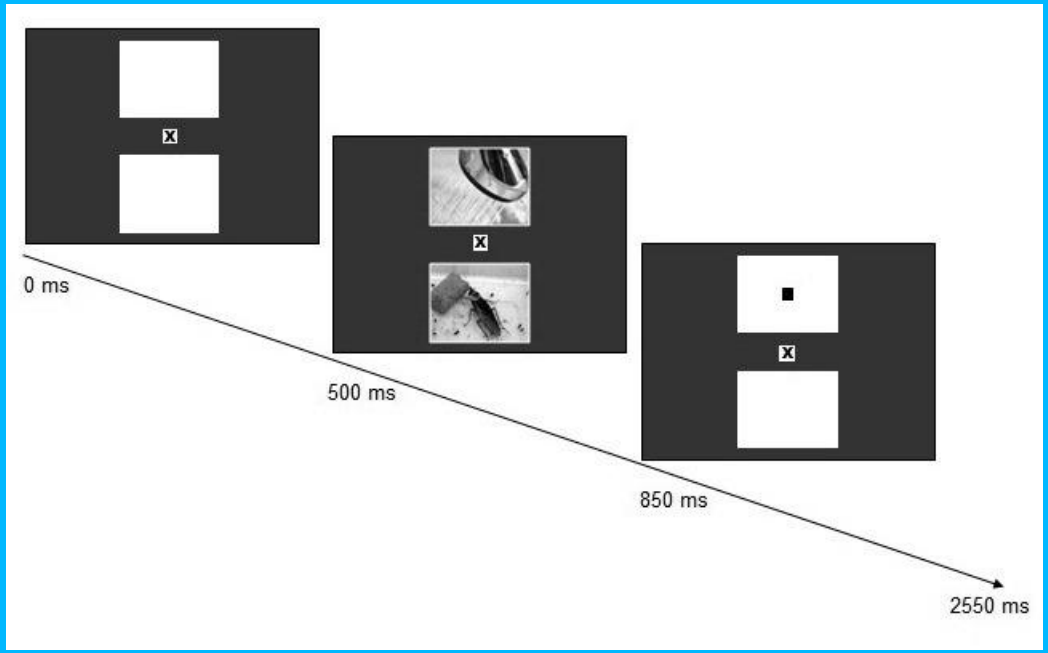
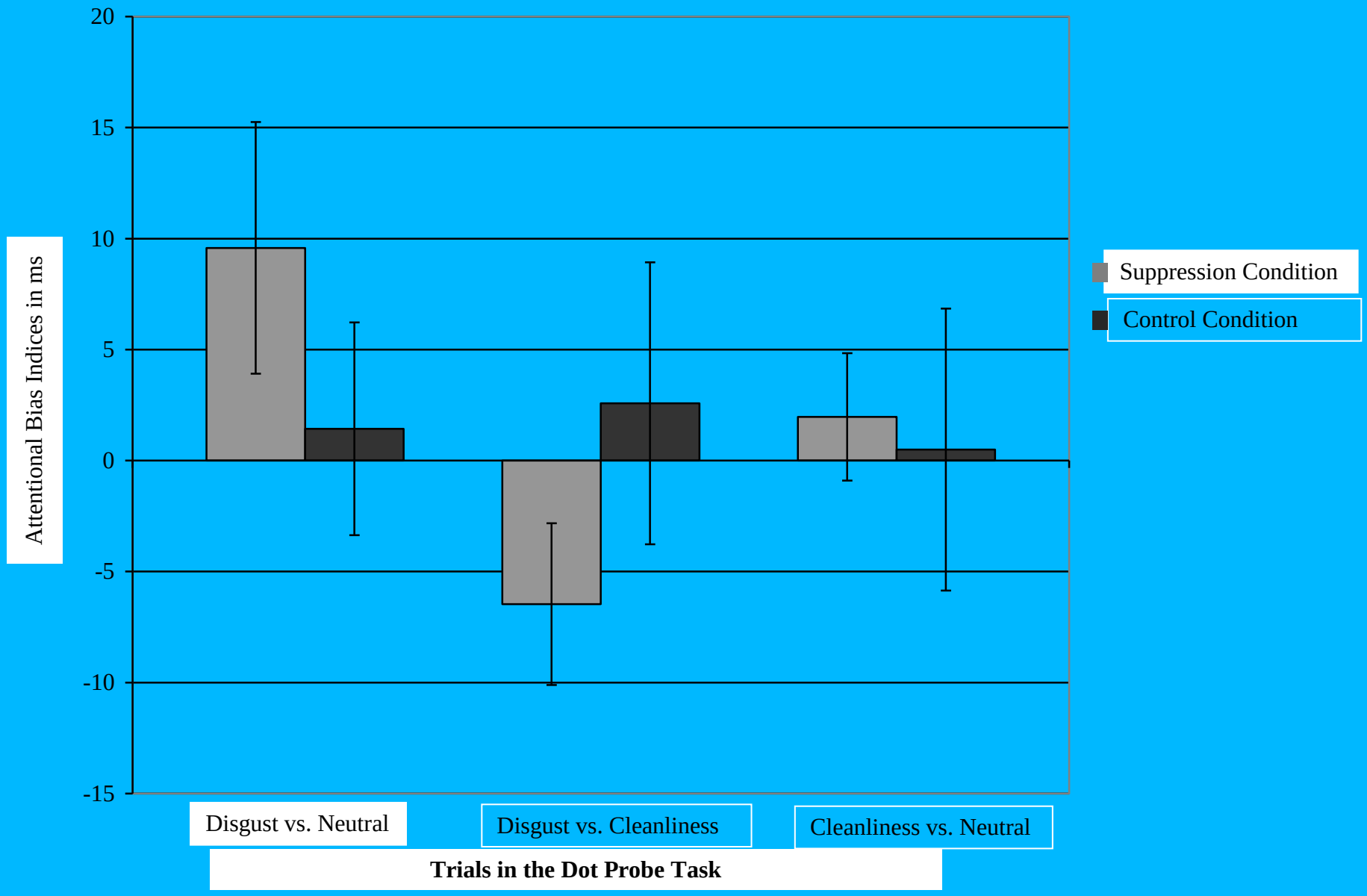


Figure 2.


20
15
10
5
0
-5
-10
-15
Attentional Bias Indices in ms
Suppression Condition
Control Condition
Disgust vs. Neutral
Disgust vs. Cleanliness
Cleanliness vs. Neutral
Trials in the Dot Probe Task